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Motorcycle Maintenance and Test Intervals

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ABSTRACT

Maintenance and repair data from the Gallup Motorcycle Survey are analyzed and test intervals for the emission and durability data vehicles are determined. Scheduled maintenance intervals and the type of maintenance allowable for the durability vehicle are recommended. Major engine repairs are also analyzed.

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INTRODUCTION

This report presents information on routine and major maintenance of street legal motorcycles.

The Gallup Motorcycle Survey provided information on the frequency of maintenance performed on motorcycles. The questionaire asked how often the spark plugs were changed, the engine tuned up, the valves adjusted or cylinder head decarbonized, and the carburetor cleaned or disassembled. Answers in terms of miles or time (i.e. every 3 months, etc.) were obtained.

The questionaire also asked how many miles were on the motorcycle when various major repairs were first performed. Major repairs included pistons and rings, valves, bearings, and carburetor replacement or rebuilding.

Based on the average maintenance intervals and the useful life, test intervals for the data and durability test vehicles were determined. The major repair items were examined to determine if any major repairs were likely to be necessary within the durability demonstration distance.

The analyses performed are based on street and dual purpose motorcycles with working odometers.

SUMMARY AND CONCLUSIONS

- The scheduled maintenance intervals are 3000 km (< 170 cc) and 4000 km (≥ 170 cc), and are based on the average interval between tune ups.
- Cylinder head decarbonization should not be allowed as scheduled maintenance.
- Test points for the durability data vehicles are every 1500 km (< 170 cc) and 5000 km (≥ 170 cc). A minimum of 12 emission tests will be required for each displacement category.
- Within the useful life distance, there is a significant chance major engine repair will be required. It is expected that engine reliability may be a problem for the durability vehicle.

DISCUSSION

Routine Maintenance

The Gallup Survey included four questions concerning the frequency at which routine maintenance was performed. Each motorcycle owner was asked how often the following was done to his or her motorcycle:

a. Change or clean plugs
b. Engine tune up
c. Decarbonizing the cylinder head or adjusting the valves
d. Disassemble and clean the carburetor

The owner could give several types of answers by responding with a time (i.e. once a year), a distance (i.e. every 8000 miles), or a negative answer such as "never", "haven't done yet", "don't know", etc.

For question c, it was assumed that only the 2-strokes required decarbonization and only the 4-strokes required valve adjustments.

Table I presents the average distance and median time at which routine maintenance was performed. The statistics are based only on motorcycles for which maintenance was performed, that is, the "don't knows", "not yet" answers were not included.

Table I

Frequency of Routine Maintenance
(Based on those Performing Maintenance)

	Average Distance, km		Median Time, mo.	
Type of Maintenance	≤ 170	> 170	≤ 170	> 170
a. Plugs	1771	3339	6	4-5
b. Tune up	2771	4009	12	12
c.1 Decarbonize head (2-stroke)	3153	4497	12	12
c.2 Adjust valves (4-stroke)	4771	5859	12	12
d. Clean carburetor	4098	7010	12	12

Also of interest is the percent of the population which actually performed the routine maintenance. Table II presents these data for those motorcycles with at least as much accumulated distance as the average distance at which maintenance was performed (from Table I). Thus motorcycles with low accumulated distance, which may not have needed routine maintenance yet, are excluded.

Table II

Percent of Population Performing Maintenance
(Based on Motorcycles with Accumulated Distance $\geq$ that shown in Table I)

Type of Maintenance	Percent	
	$\leq$ 170 cc	$\geq$ 170 cc
a. Plugs	77	85
b. Tune up	65	78
c.1 Decarbonize head (2-stroke)	41	44
c.2 Adjust valves (4-stroke)	40	58
d. Clean carburetor	51	49

Table II shows that the majority of the population has performed plug changes and tune ups, about one half has performed carburetor maintenance and adjusted valves, and less than one half has performed cylinder head decarbonization. Although a tune up normally consists of plug, ignition, and valve maintenance, the data indicate plug changing or cleaning occurs more frequently and valve adjustments less frequently than the tune up.

Based on these data, the average tune up interval is chosen as the interval for allowable scheduled maintenance for durability vehicles. The allowable scheduled maintenance intervals are,

$\leq$ 170 cc 3000 km
$\geq$ 170 cc 4000 km

and include ignition and spark plug maintenance, and valve and carburetor adjustments.

Although the data indicate spark plug maintenance is performed more frequently than the tune up, a special service interval for spark plug maintenance is not required. It is expected that plug life will increase as the unburned HC and oil emissions are reduced for controlled motorcycles. Also, an overt indication of spark plug misfiring can result in approval for unscheduled spark plug maintenance.

Including valve adjustments as part of the tune up (at a shorter frequency than the data indicate) is based on similarity to the LDV procedure and simplification of the durability test cycle.

Although carburetor disassembly and cleaning is performed by one half the population at a distance less than the durability distance, it is recommended that carburetor disassembly and cleaning not be allowed. (Idle speed and mixture adjustments may be performed at the scheduled

maintenance points.) Due to the accelerated rate of mileage accumulation, it is less likely that carburetors will need cleaning and disassembly.

To allow cylinder head decarbonization of 2-stroke engines as scheduled maintenance means access to the combustion chamber must be allowed, which is currently forbidden in the LDV procedures. The Gallup data, however, indicate that this maintenance is performed by a significant portion of the population. The pros and cons of allowing cylinder head decarbonization are presented below:

Pro: - Gallup data indicate over 40 percent of 2-stroke motorcycle owners perform decarbonization.

- Decarbonization is recommended in the owners manual of most 2-stroke motorcycles.

- Decarbonization of 2-strokes requires only the removal of the cylinder head; other engine components are not disturbed.

Con: - Decarbonization requires access to the combustion chamber.

- Decarbonization affects emissions. (The presence of carbon deposits may increase HC and NOx emissions.)

- Less than one half of the population of 2-stroke owners performs decarbonization.

- Controlled motorcycles are less likely to need decarbonization.

The arguments against allowing cylinder head decarbonization outweigh those in favor of it, and therefore it is recommended that cylinder head decarbonization not be allowed as scheduled maintenance. Because this decision is partially based on the survey question, which may have been confusing (a large number of "don't know" replies occurred), the question of decarbonizing should be reconsidered if additional evidence is presented in the comments to the NPRM.

Test Intervals - Emission Data Vehicle

The recommended test points for the emission data vehicle are:

≤ 170 cc 0, 3500 km
> 170 cc 0, 3500 km

The final test point was chosen to be at as large a distance as possible to allow emission stabilization while not exceeding the scheduled maintenance distance. This reasoning was used because no information on emission stabilization of motorcycles was available.

Test Intervals - Durability Data Vehicle

The durability data vehicle test points were chosen to minimize the number of emission tests while still providing enough data points to determine the deterioration factor. The test points are shown in Table III.

Table III

Durability Data Vehicle Test Points, km

≤ 170 cc	> 170 cc
0	0
1500	5000
3000	10,000
4500	15,000
6000	20,000
7500	25,000
9000	30,000
10,500	
12,000	

A minimum number of tests occurs when the scheduled maintenance points coincide with durability test points. Since an emission test is required before and after maintenance, the minimum number of emission tests required will be:

≤ 170 cc 12 tests
> 170 cc 12 tests

For motorcycles with displacements greater than or equal to 170 cc, the number of tests could be as many as 20 if the manufacturer chose to perform scheduled maintenance at the minimum allowed interval of 4000 km.

No scheduled maintenance shall be performed after the following accumulated distances:

≤ 170 cc	10,500 km
≥ 170 cc	18,000 km

The tolerance on the test points is 250 km.

Major Repairs

The Gallup Survey asked motorcycle owners what distance their motorcycle had accumulated when piston and ring repairs were done the first time. The question was repeated for bearing and valve repair. The owner was also asked how many miles were on the motorcycle when the carburetor was rebuilt or replaced.

The data were analyzed for original owner motorcycles only, because for those motorcycles purchased used, the first time a repair is required for the current owner may not be the first time the repair was performed on the motorcycle. Table IV shows the percent of original owner motorcycles which required repairs and have accumulated distances greater than or equal to the useful life.[1]

Table IV

Incidence of Major Repair
(Original Owner Motorcycles with Accumulated Distance ≥ Useful Life)

Type of Repair	Percent ≤ 170 cc	Percent ≥ 170 cc
Pistons & Rings	21	23
Valves (2-stroke)[2]	13	4*
Valves (4-stroke)	20	22
Bearings	6	14
Carburetor	5	22

*Small sample size (27).

[1] 12,000 km for ≤ 170 cc, 30,000 km for ≥ 170 cc.

[2] Valve repair for 2-stroke engines is assumed to be repair to reed or rotary valves.

The data show that for each major repair item, less than one quarter of those motorcycles exceeding the useful life distance has required that specific repair. Table V presents the percentage of motorcycles needing no major repair of any type during their useful life.

Table V

Motorcycles Requiring No Major Repair
(Original Owner Motorcycles with Accumulated Distance ≥ Useful Life)

	Percent
< 170 cc	61
≥ 170 cc	51

The data in Table V show that slightly more than one half of those motorcycles with accumulated distance greater than or equal to the useful life have required no major repairs. The other one half have required at least one of the major repairs.

Finally, the average accumulated distance at which a major repair was first required is shown in Table VI. These data are based on all original owner motorcycles without regard to the accumulated distance.

Table VI

Distance at which Major Repair was Required
(Original Owner Motorcycles)

	Distance - km	
Type of Repair	< 170 cc	≥ 170 cc
Pistons and Rings	9343	10,948
Valves (2-stroke)	4784	8,399
Valves (4-stroke)	4797	19,612
Bearings	4618	13,400
Carburetor	3940	12,500

From the data presented in Tables IV - VI, it can be deduced that there is a good chance that a major internal engine repair will be required by the time a motorcycle accumulates the useful life distance. This assumes that the distance accumulation occurs over the normal lifetime of the motorcycle, which is 5.5 years for small motorcycles and 7.5 years for large motorcycles. With the accelerated distance accumulation and rigorous maintenance of the durability vehicles, it is expected that the probability of a major repair being needed will be reduced. It remains, however that reliability may be a major problem for the durability vehicle.

Limitations of the Major Repair Data

The use of survey data to analyse major repairs, which may not have occurred recently and require estimates of what mileage the repair occurred at, limits the confidence of the results. Because only a small percent of the sample population is high mileage motorcycles, and due to the limitation of considering only original owners, the sample size used was small. There is also the limitation that motorcycles which have accumulated the useful life distance (which these results are based on) tend to be motorcycles which are 5 to 10 years old. It is possible that the reliability of a current model year motorcycle may be much different.

The analysis of major repairs will be repeated if more useful information such as fleet or service data become available; possibly such data will appear in the comments to the NPRM.